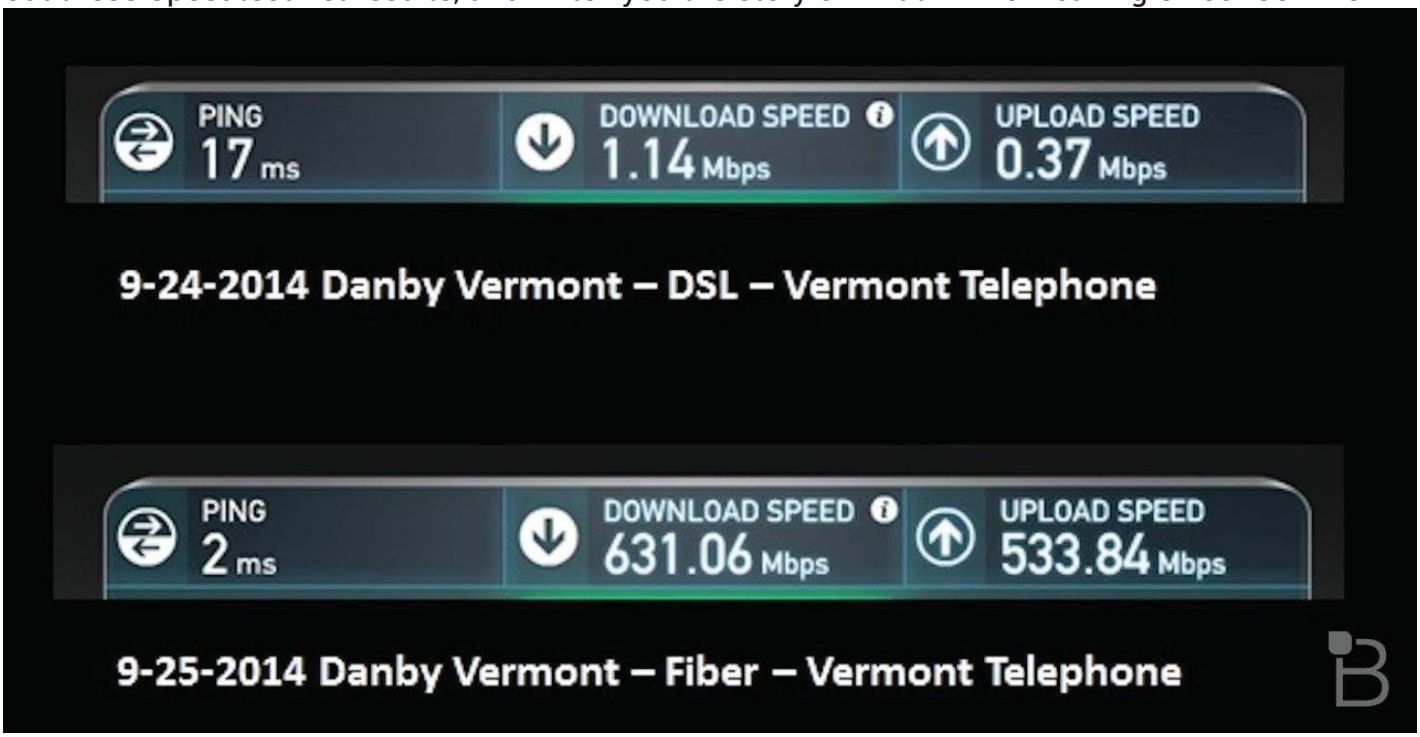
Rural Vermont, Home To The Fastest Internet In The U.S.

http://www.technobuffalo.com/2014/10/11/what-a-difference-a-day-makes-rural-vermont-now-home-to-fastest-internet-in-the-u-s/?

10/14/2014

My comments are italic & magenta - TRB

How did I go from just over a megabit of poky DSL on Wednesday to over 600 Megabits of fiber-fast Internet connectivity on Thursday – in one of the most rural parts of the northeast? Check out these Speedtest.net results, and I'll tell you the story of what I'm now calling SiliconCowPie.



When I purchased 30 acres of land on the side of a mountain in Danby Vermont in 1987, it was to own a piece of the state I'd come to love, and to take my New York City friends camping on summer weekends.

My wife and I built a house in 1997, and then immediately moved to California to start ZDTV. It was either sell or rent, and we opted to rent it out and use it when we could.

When we built, there was barely phone service, but even so I wired the house up with Cat5 cable, hoping for the Internet someday. Someday arrived about ten years later, with super-slow DSL. It worked, but not for much beyond loading Yahoo.com.

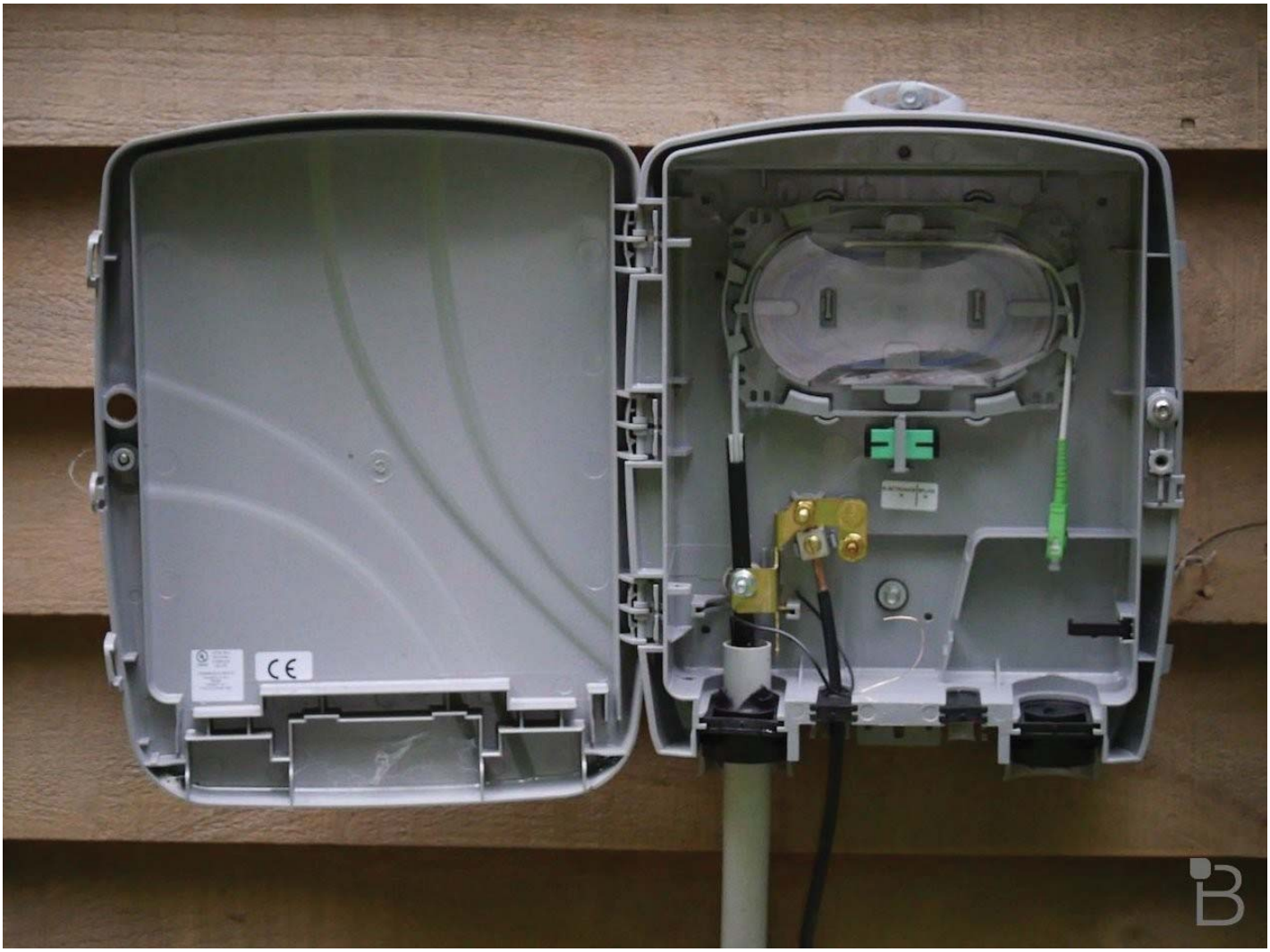
Line 16 – CAT5 cabling is a standard cable that can be purchased at any Home Depot or Lowes store. It is typically used for Ethernet cabling in homes and businesses.

Turns out I picked my land well, though. Vermontel (VTEL), the rural telephone company that served Tinmouth, along with 12 other towns across a swath of southern Vermont, wasn't some Podunk cooperative. Instead, it was owned and managed by the visionary technologist Michel Guite. He's plucky too – back in 2010 he convinced the U.S. government to give him an $81 million

dollar grant and a $35 million loan to reprise the Rural Utilities Service and replace copper with fiber.

Now, four years later, VTEL is almost done. And since our house is about as far from VTEL's home town of Springfield as possible – and still be in their coverage area – I was nearly the last to be connected. I'd seen the trucks rolling around the mountains last spring, and then a few days ago I came back to Vermont to check on the house – and my Internet.

Lo and behold, a new box was hanging off the side of my house when I rolled up.



Line 38 – Shows a typical Calix housing. The fiber optic cable is dressed into the box using standard PVC electric conduit. On the left is the standard #6 Awg grounding wire routed to a driven ground rod directly below the Calix housing. A single fiber strand is wound around the organizer in the back of the housing and is terminated into a standard capped fiber optic connector (green) on the right.

Over the summer VTEL ran a fiber strand from their remote hub in Wells – about five miles away – all the way to my house. They even snaked it up through the conduit buried along my ¼ mile

driveway.
Inside that simple grey box, as you can see, is a lovely strand of fiber, already capped with a green plug. By the way, doesn't it look like there's an 8-bit Space Invader hiding in the top of the box?

Forget fiber to the curb. I now had fiber to the porch. But I wanted it INSIDE the house too. I called up VTEL and after a little pleading they promised to try to connect it during the three days I was there. First one of their technicians came up to make sure that the line showed continuity; meaning that a photon shot down it from the box on my house successfully made it to the hub in Wells, VT. That worked.

Then the next day another group showed up to double check everything was working. And finally, as night was falling on my last day in Vermont George Talatinian and Wayne Woodbury rolled up the hill to make the connection and bring my own rural corner of Vermont into the space age.

Fiber Hero George Talatinian

Both Wayne and George are hard-nosed, grizzled veterans of the telecommunications age.

Wayne's a Coordinator on VTEL's fiber project, and started working at The Telephone Company (there was just one) back in 1983. He moved into fiber in 1987, and never looked back. George is the technician who gets everything done, from splicing wire to drilling holes in homes to troubleshooting problems on the ground. Both worked extensively on Verizon's FIOS project, and felt the pain when the company essentially abandoned northern New England to its own devices.

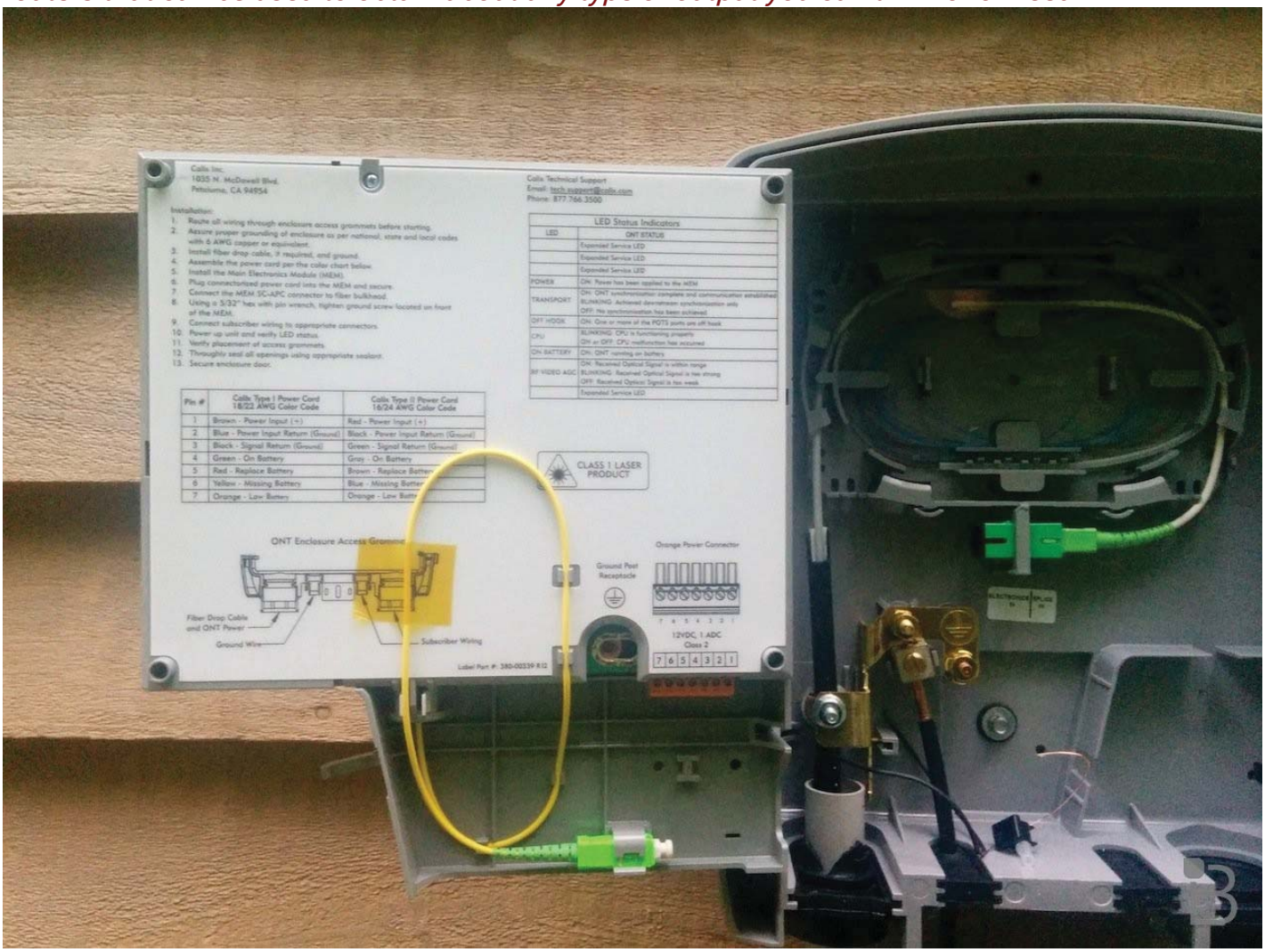
Line 65 – Shows the Calix high speed optical router and the output to standard metallic tip and ring Plain Old Telephone System (POTs) jacks (bottom green-red) labeled Line 1 and Line 2. These jacks get routed into the structure and to industry standard analog telephone sets. Directly above these jacks are two more labeled ENet 1 and ENet 2. At least one of these jacks gets routed to a piece of Metallic Cat 5 or Cat 5E cable and on into the structure. The ENet ports are responsible for delivering the very fast Internet service to the structure.

Much to my surprise, the bulk of the hardware sits outside, not inside. The first thing Talatinian did was snap a hardened Calix Router into that box.

The Calix Router transforms the optical signals from the fiber into gigabit Ethernet (gigE) and telephony (POTS), depending on the type of packet it receives. My box has two gigE and two POTS

ports, but I only needed one. They make a 4×4 version too, for small apartment buildings, but that would be overkill for me. Just about all the smarts sit in that box while everything inside my house stays the same – from wireless router to POTS lines.

Line 78 – The fiber data rate is so high that there is an entire family of different types of optical routers that can be used to obtain about any type of output you can think of or need.



Line 84 – Shows the back of the optical router with the glued on options sheet listing options and attachment points. The yellow cable is again, a single fiber optic strand and connector that plugs into the housing fiber connector.

On the back of the router is where the magic happens. Here's where the connection gets made. And with a deft hand, Talatinian snapped one green plug into the other, and my fiber was connected.

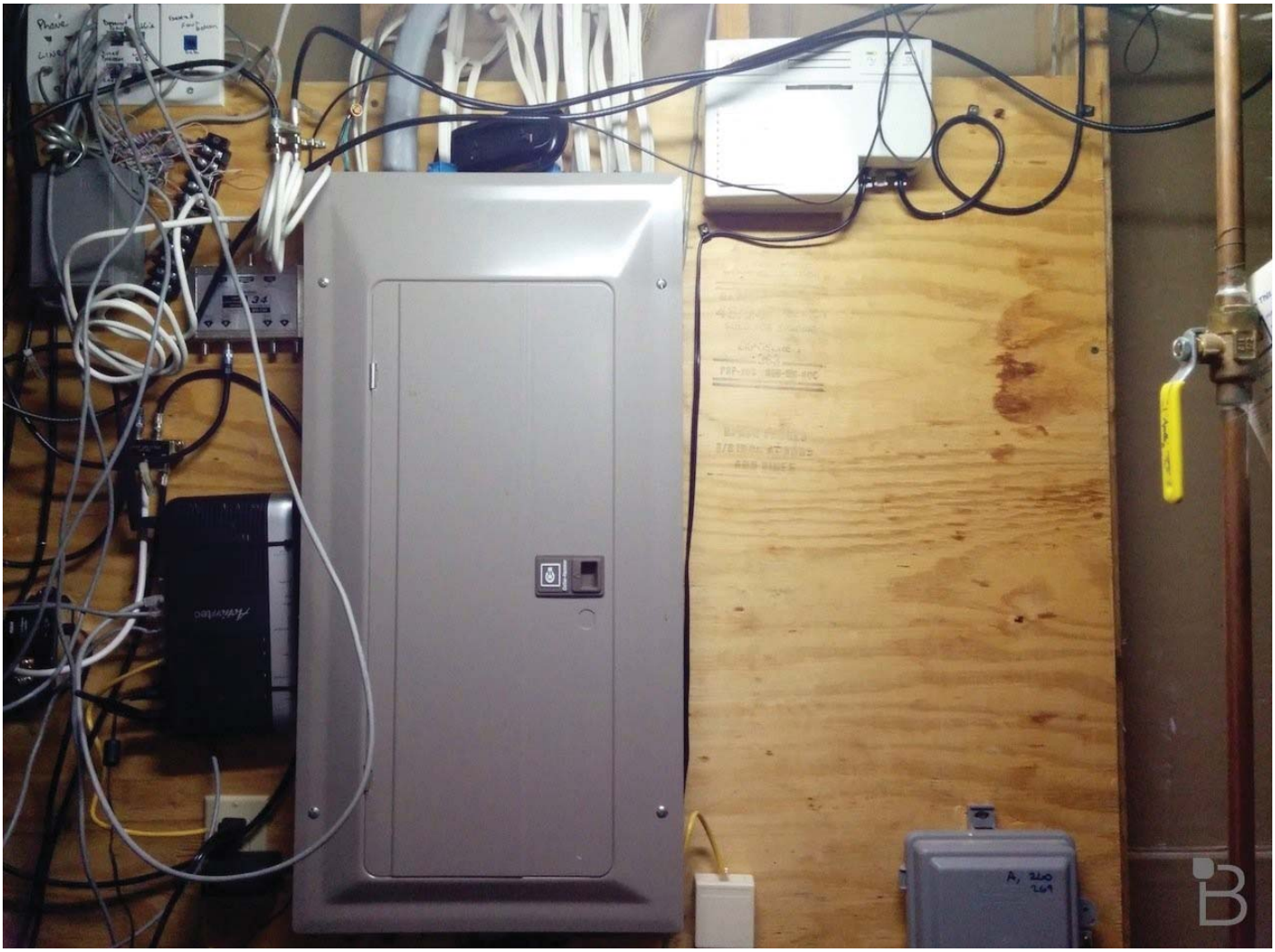
Well, not quite. The router still needed power – as far as I know, they still haven't invented POF (Power Over Fiber). So next he drilled a hole in my house, and spliced together a power cable to juice-up the Calix. He also ran two Cat5E cables from the Calix to inside my house using that same hole – one to connect up to my home router, the other to my phone system.

But one last piece of equipment had to be installed inside the house.

Line 98– Shows the Cyber Power lead acid backup battery unit used to keep the fiber gear running should there be a commercial AC power failure. These units typically keep the fiber gear powered and working for around three hours give or take.

Because both phone and Internet were running over the fiber, and because phone lines provide enough power to activate a handset, the company needed to provide backup power so phones would work if the electricity went down. And down it does go. Sometimes I feel like my corner of Vermont is only marginally better than a third world country. So Talatinian spliced the power cord from the Calix router to the battery backup, and then plugged that box into an AC outlet.

A few phone calls and a quick update to my home router and it was done. Suddenly I had faster Internet than 99% of the US.



Line 118 – Messy power panel & back board. Note the RG-6 cabling to the left of the box probably for Dish or Direct TV. The fiber is fast enough to deliver video programming far superior than anything from Direct or Dish.

Yes, that's my wiring closet. It's not pretty, but boy is it smoking!

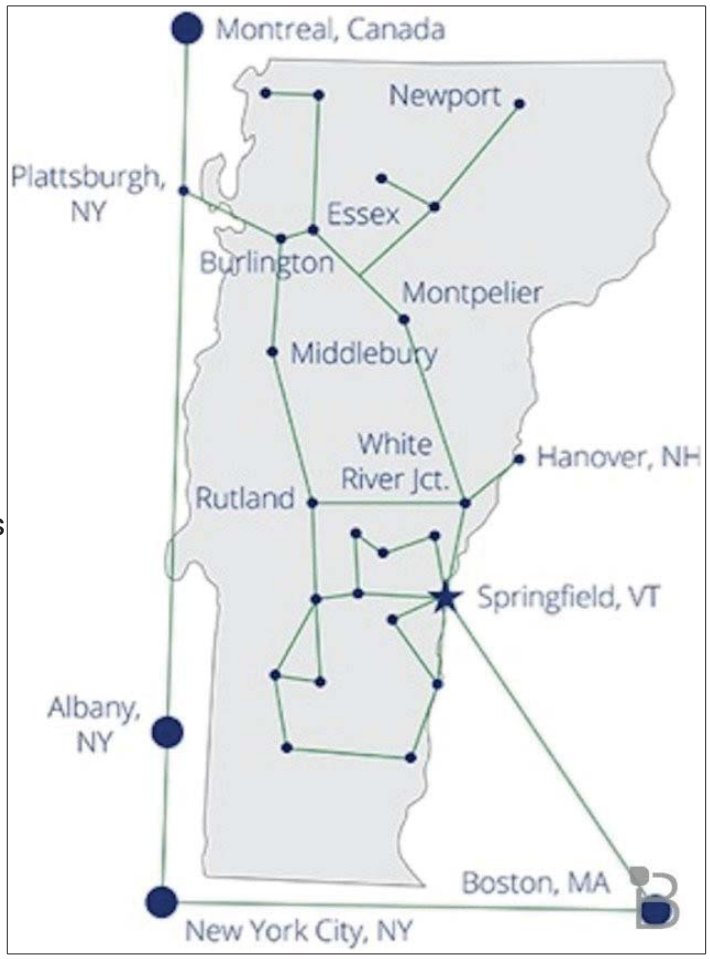
You already know how it performed after installation – the results were amazing. And according to Woodbury, the company is doing it right. Unlike in Kansas City, where Google laid fiber out on top of the copper infrastructure, VTel wants nothing more to do with that ancient relic of a simpler age. Voice, Video and Internet are all being delivered over the new fiber plant. In fact, the final phase of the project will be to pull down all the old copper wires and presumably sell it for scrap.

Line 125 – Very true. Dump copper everything and haul it to the scrap yard. It is no longer needed or wanted.

In addition, VTEL's fiber network is "active", which means that every house home-runs to a remote central hub in each town – and each of those hubs are interconnected with an even faster set of bonded 10Gigabit Ethernet fiber trunks.

Line 130 – The fiber used in this system is routed directly back to a head end (originating OLT) box and a very high speed (10 gig+) optical router. There is no sharing with other users by way of passive optical dividers.

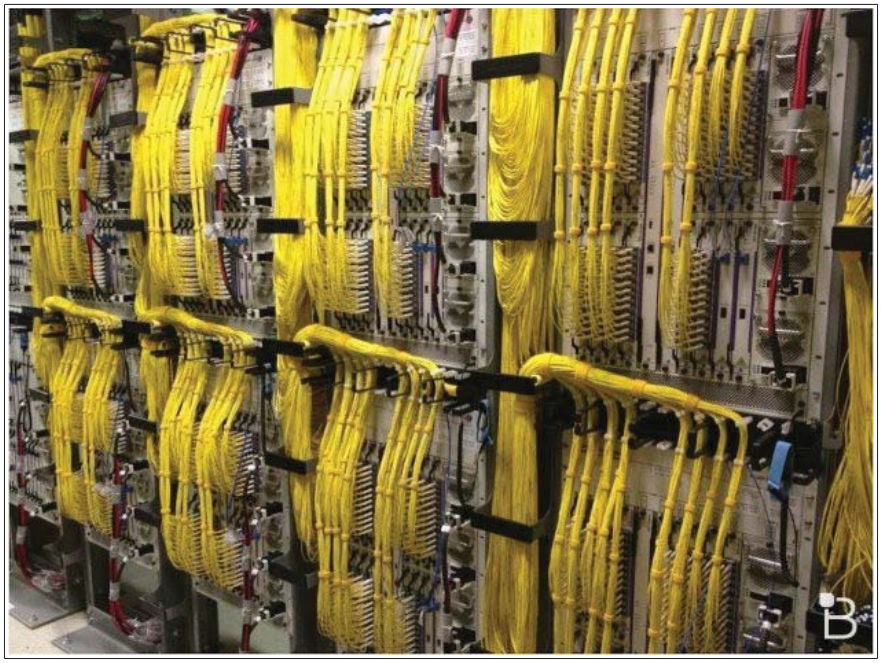
Here's what the main hub in Springfield Vermont looks like:



Compare that to Verizon's FIOS network, Woodbury explained to me, which splits each fiber strand into 32 passive pairs. That means 32 houses could be sharing a single gigabit fiber strand, which seriously cuts into available bandwidth, particularly when Game of Thrones Season four debuts in April. ***Note!***
Line 142 – Again, for maximum speed, passive optical dividers where up to 64 users share a single optical feed, are to be avoided.

The network itself is built with those Calix routers at each home, and some Juniper and Alcatel equipment handling the head-end and long-haul transmissions. As for connecting to the rest of the Internet, VTEL has a regional DWDM optical network that connects their home office in Springfield Vermont to Montreal, New York and Boston. According to VTEL CTO Justin Robinson, "The DWDM network is capable of carrying dozens of 100Gig wavelengths… although to be truthful we have yet to exhaust the capacity on our first 100Gig wave yet."
Line 153– There is a group of interoperability standards that let different makes of equipment talk to one another. In this system an originating Alcatel-Lucent box is talking to the Calix box. The Calix box has a feature where it can detect if it's seeing many multiple addresses being sent (optical divider box) or only one address sent (direct optical router feed). It then is able to configure itself properly without the need for a truck roll to manually option things. On the backbone side (long haul transmission), two fiber strands are used. One for transmit and one for receive. Dense Wave Division Multiplexing (DWDM) uses different color light to stack multiple separate systems on a single fiber pair. You can look this up on Google but I believe the current limit on the number of systems that can be stacked is over 100. Transmission data rates are typically much higher as well ranging to 100 – 400 Gbps. Note – as of a year and a half ago there were very few home routers capable of delivering full, reliable, 1 gig connectivity on both the LAN as well as the WAN side of the router. I'm surprised this fellow got as fast a connection as he did without changing the router.

Here's what the network looks like. All that bandwidth helps ensure that my super-fast connection gets out to the rest of the Internet in a timely fashion. According to Robinson, VTEL is only using about 20% of its capacity at peak, which leaves a lot of headroom. What's even more exciting, at least for me, is that by just changing out a router card they can upgrade my house from 1 gigabit to 10 gigabits of connectivity. Woo and Hoo!



Line 187 – Carl Russo, CEO of Calix, successfully negotiated a deal with Ericsson to obtain a portion of Ericsson's product line (1500 GPON) that is capable of delivering full 10 gig optical connectivity to end users. As stated, a simple router card change out is all that is required to bump up to 10 gig delivery. Category 6a cabling and appropriate plugs & jacks are a requirement for this speed range.

So how did it work in reality? Sure, I expected super-fast bandwidth to VTEL's own servers, but what about to the Internet at large? I only had time for a few tests, but I was grinning like a banshee during most of them.

I ran Speedtest.net to servers in Rochester, NY and New York City, and saw some awesome throughput, although the 48ms ping time to Rochester – less than 300 miles away – was somewhat worrying.

I tested three servers on the west coast as well. I expected to see a longer ping time – we're talking speed of light here after all – but I was still impressed with two of them. Softlayer in San Jose, CA hosts a number of startups,

VTEL To Everywhere

which bodes well for future performance. And even though Comcast is locked in a nasty competitive battle with VTEL for triple play customers in some of the less rural parts of Vermont, Comcast doesn't seem to be messing with Net Neutrality elsewhere, as its Seattle servers delivered results similar to Softlayer.

I was concerned, though, by the results from the Fiber Internet Center in Palo Alto, CA. But because these miserably poor numbers were an anomaly, I'll chalk it up to something to investigate, not a ding on performance.

So the benchmarks check out OK. What about application tests? I ran video tests across HBO Go, Amazon Prime Video, Netflix and the DirecTV GenieGo in my house in San Francisco. The first three almost immediately snapped into HD mode when I started streaming, and looked great. Netflix has a video on its servers that lets you test bandwidth, but unfortunately it only goes up to around 3 megabits per second, and it easily reached that in about 3 seconds.

I'd really like to see Netflix come out with a similar test video that can crank all the way up to 4K – I'm excited to test out the potential of 4K video on my new fiber-equipped mountain cabin.

The GenieGo, however, looked terrible. Again, I'm thinking this is an anomaly, probably either related to the GenieGo or my own home networking setup. I'll be doing more testing there – and also with the latest SlingBox – to see how well I can move video from my home in Pacifica to my fiber-outpost in SiliconCowPie.

Oh, and I did evaluate two of the more common NC-17 skin sites – for testing purposes only, mind you –Results with HD videos were similar to what I saw with Netflix, Amazon and HBO GO. In fact, the handful of videos I played started more quickly than either of the three more mainstream services. I didn't stick around, however, long enough to guage whether picture quality was comparable as well.

Finally, I did some bit-torrent testing. I grabbed 10 torrents of concerts from bands that approve of fans sharing their live music performances – mostly old Phish and Dave Matthews Band. Using the latest uTorrent client and a proxy service in Canada, I saw upwards of 14 megabits per second of cumulative throughput across those 10 files, which is pretty darn good. However, after about 10 minutes of torrenting, standard HTTP calls to eTrade, Yahoo and other sites started failing. I closed uTorrent and they snapped back again. According to VTEL, this is probably due to QOS settings in the home router they connected up to the CALIX router on the outside of my house. I'll be testing that in the future.

I learned a few other interesting things as well during my tests. First, there are still some tin-foil hat wearing folks in my neighborhood in Vermont. About 2% of VTEL's customers refused to let them install fiber into their homes – and a few wouldn't even let them past the property line. And that was after the very patient VTEL folks explained that in a few months they'd be getting a note saying that their phone service was going away, and only the essential 911 service would be

available. For six months. After that, they would be completely cut off, because the copper was coming down.

Line 260– There are lots of tin foil hat wearing people in Colorado. Yes, copper land lines are going away to be replaced with fiber and the sooner the better. You don't need to be rural poor to be a tin foil hat person. In my experience, there are quite a few Colorado politicians and community leaders that fit this definition perfectly.

And back in 1997 when I wired up my house, for some reason I only jacked in 1,2,3 and 6 – the two pairs needed to make 10 and then 100 BaseT Ethernet work. But much to my surprise Gigabit Ethernet requires all four pairs in that Cat 5E or Cat 6 wire (the E stands for enhanced, and it's because original Cat5 cable had substandard wiring for the non-used strands).

Line 273– Ethernet switches, hubs, routers and associated cabling all need to be rated for 1 gig or higher to work with fiber delivered gig Internet. With the jacks and plugs available today, it's pretty hard not to connect all four pairs correctly.

Lots more testing to do, and I need to re-terminate my in-home cables with Cat5E modular plugs, but that's a small price to pay. And according to Robinson, if I connect my PC directly up to the CALIX router on the outside of my house I could see 950 Mbps or more bandwidth. WOW.

Consider me a VERY happy customer. I'll have more, pitting VTEL's fiber against what Comcast claims is 100 megabit cable-delivered IP to my NoCal house, along with more tests on connecting the two homes together, over the next few months.

This install is not unique. It is being duplicated in many parts of the U.S. Comcast cable and like systems should now die a slow death. I see nothing on the horizon capable of easily delivering 10 gig connectivity when needed and over many miles, except fiber.